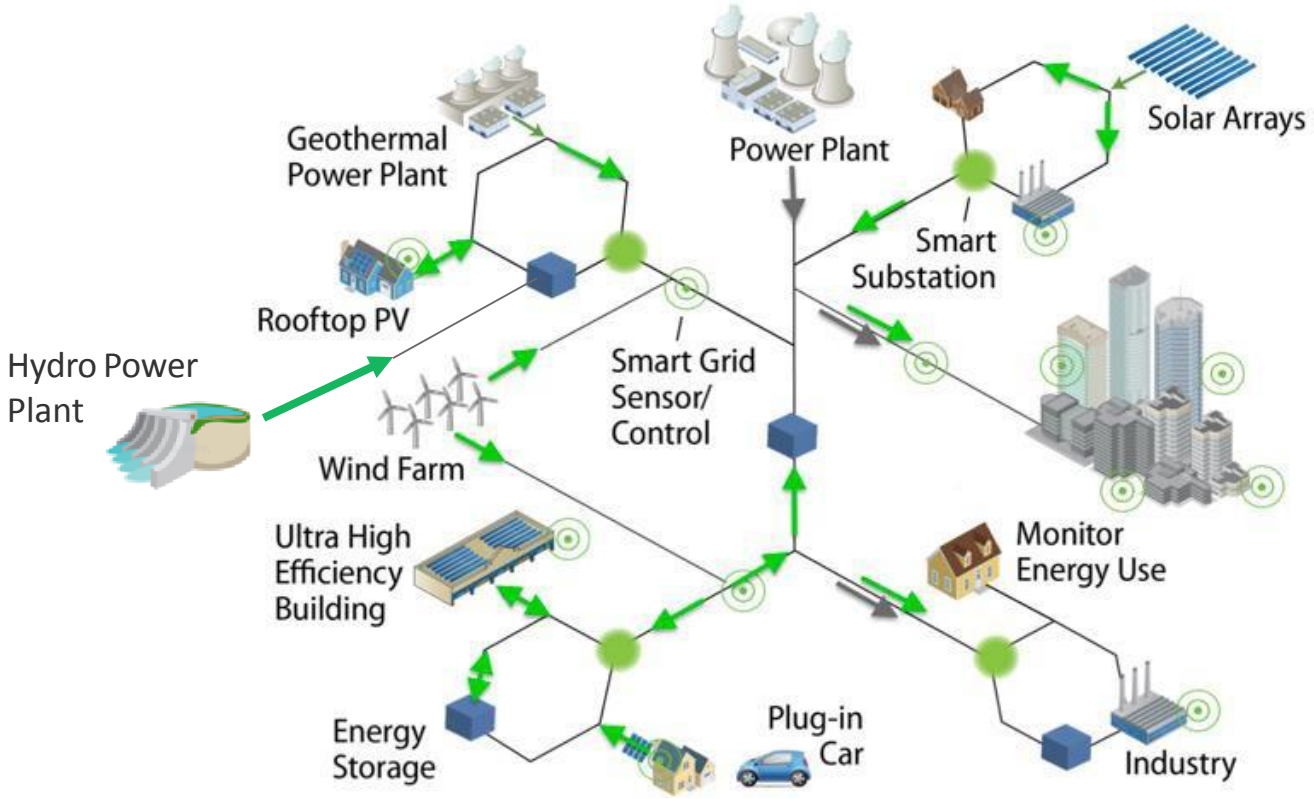
IEA Wind TCP Task 41: Enabling Wind to Contribute to a Distributed Energy Future Progress Report



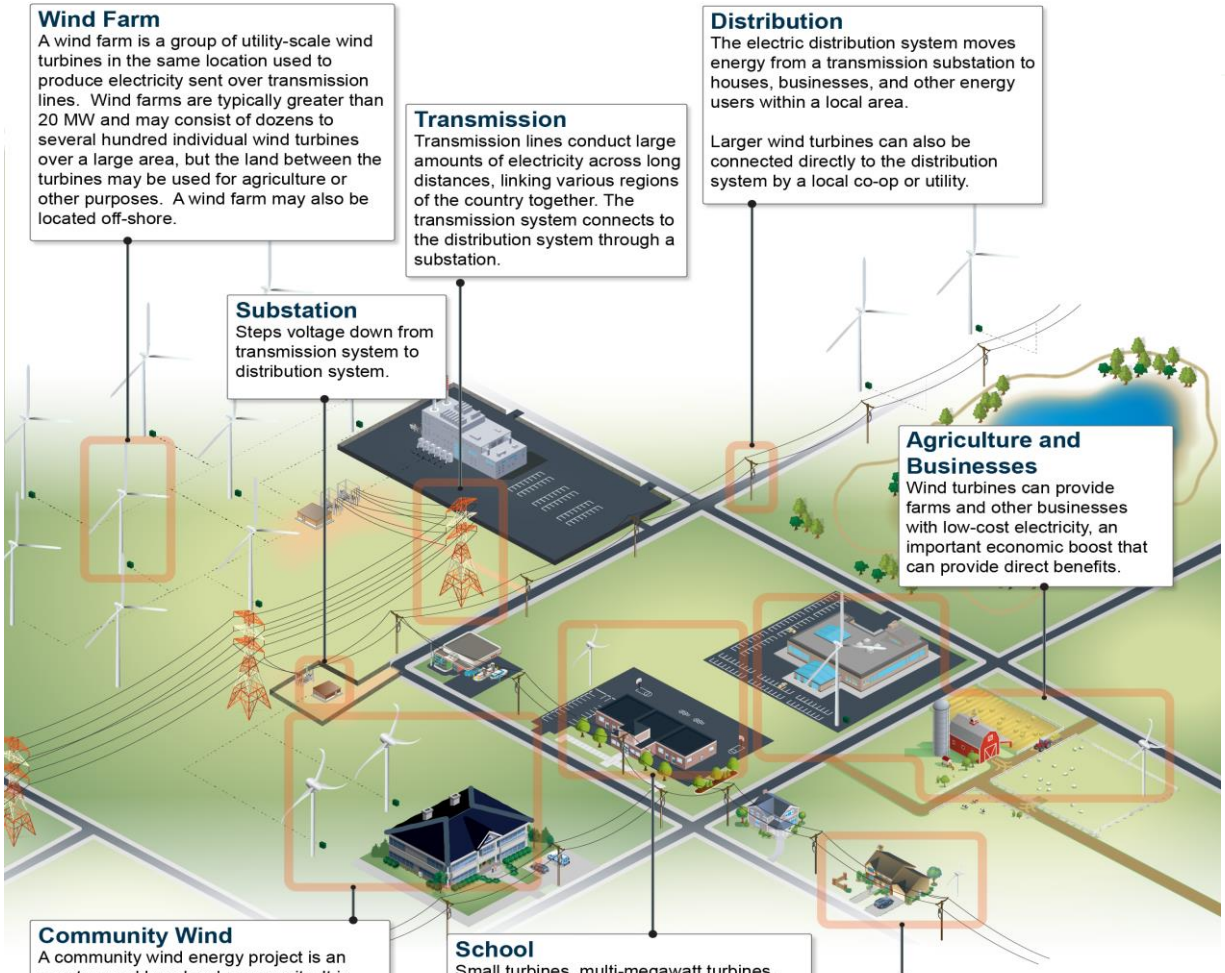
Bret Barker, Advisor to the U.S. Department of Energy

IEA Wind TCP ExCo 84 | Copenhagen, Denmark

September 17-19, 2019

iea wind

How Does Task 41 Define Distributed Wind?



Graphic: National Renewable Energy Laboratory / U.S. Department of Energy

- Wind turbines connected at a distribution voltage (nominally 70 kV or lower) in a behind-the-meter, in-front-of-the-meter, or off-grid application
- Distributed wind is inclusive of all wind turbines size classes

Task Objectives and Expected Results

Project Objectives and Outcomes

- Expand international collaboration to lower the costs and deployment barriers for distributed wind technologies
  - Update domestic and international distributed wind turbine standards
  - Develop research and data catalog for distributed wind
  - Publish state-of-the-industry report on the integration of distributed wind systems
  - Identify downscaling opportunities for distributed wind
- Promote expanded engagment in the wider distributed energy research and deployment markets
  - Produce best practice guide for high-renewable-contribution isolated power systems
  - Expand collaboration across IEC TCPs on wind deployment and integration

Target Audience

- Wider distributed wind and distributed energy industry
- IEA wind and wider TCP research efforts
- Domestic and international investment and development community

Current Term: Jan 2019-Dec 2022.

Work Package Overview

WP0: Management and Coordination

WP1: Progressing Distributed Wind Technology Design Standards for Small- and Mid-Size Wind Turbines

WP2: Data Information Catalog

WP3: Expand Learning and Support of the Integration of Distributed Wind into Evolving Electricity Systems

WP4: Outreach and Collaboration with Other R&D Activities

WP5: Innovation and Downscaling of Utility-Scale Technology

WP1: Standards
Technical Results

- Standards meeting in North America (USA in February) and Europe (Ireland in June)
- Identification of key concerns with existing small and mid-scale wind turbine standards:
  - Needed for better breakout based on turbine size with different standards requirements
  - Duration test requirements slow innovation and time to market
  - The need for simplified loads methodology and validated aeroelastic models
  - Tower dynamics are not well addressed in IEC 61400-2
  - Power performance results are rarely matched at consumer sites
  - Many of the current requirements found in the design classification don't reflect the commercial reality for micro and small wind turbines
  - There are no defined considerations for conformity assessment
  - Acoustic testing is considered the most difficult of all the small wind turbine test methods.

WP2: Data Information Catalog
Technical Results

- Reviewed existing databases and portals for inspiration and collaboration potential
  - Tethys
  - Sharewind
  - DAP
  - OpenEI

Data Archive and Portal (DAP)

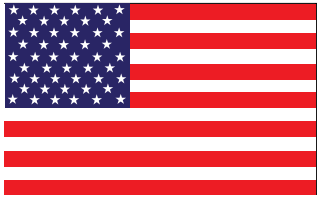
- Initiated data collection
  - Collected metadata from the Dundalk Institute of Technology as an example to create a data collection template

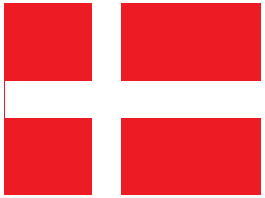
WP3: Integration

Technical Results

- Modeling & Simulation Tools
  - We assessed 127 different modeling and simulation tools on how distributed wind is represented in each tool compared to other distributed energy resources
- Grid Codes
  - Initiated review of existing grid codes for China, Denmark, European Union, Germany (partial), and United States

Tool	Catego	DW Representation vs. other DER
AMES	SIM	N/A
AMES	ECON	N/A
ASPEN Line Constants	OTHER	N/A
ASPEN Line Database	OTHER	N/A
ASPEN OneLiner	PLAN	FULL
ASPEN Power Flow	SIM	PARTIAL
ASPEN Relay Database	OTHER	N/A
ATP-EMTP	SIM	FULL
Battery Storage Evaluation Tool	ECON	N/A
C2WT	COSIM	N/A
CAPE	PLAN	FULL
COMPOSE	ECON	FULL
CRex	OTHER	N/A
CyDER (Cyber Physical co-simulation Platform for Distributed Energy Resources in Smart G	COSIM	N/A
CYMDIST	SIM	FULL
DCOPFJ	OTHER	FULL
DER-CAM (Distributed Energy Resources Customer Adoption Model)	PLAN	FULL
DEW/ISM	SIM	PARTIAL
dGEN (dWind)	ECON	FULL
DIgSILENT PowerFactory	SIM	FULL
DIS	OTHER	N/A
DiSC	SIM	FULL
Distributed Energy Resources Avoided Cost Calculator (DERAC)	ECON	PARTIAL
DistriView	SIM	FULL
Dome	SIM	FULL
DPG.sim	SIM	N/A
DRIVE (Distributed Energy Resource Integration, Valuation, and Estimation)	ECON	PARTIAL
EA-PSM	PLAN	FULL
EasyPower	PLAN	FULL
Elplek	PLAN	FULL
EMTP-RV	SIM	FULL
Energy Storage Computational Tool	ECON	N/A
Energy Storage Selection Tool	ECON	N/A
EnergyPLAN	ECON	FULL
EnergyPlus	SIM	N/A
EnergyPRO	ECON	FULL
ERACS	PLAN	FULL
ETAP	SIM	FULL
eTransport	ECON	MINIMAL
Eurostag	PLAN	FULL
FINDER (FINancial Impacts of Distributed Energy Resources)	ECON	FULL
FMI/FMU	OTHER	N/A
FNCS	COSIM	N/A
GridCal	OTHER	FULL




Deliverables

- WPO: Website implemented; general presentation created.
- WP1: Standards meeting in North America and Europe implemented and standards plan drafted. Asia meeting planning underway. Extensive industry and research laboratory engagement in meetings. Standards plan will be shared with meeting participants and will be the focus of an additional meeting in North America in 2020.
- WP3: Review of system modeling tools completed; summary being developed. Summary will be shared with industry in several forums.
- WP4: Development of task engagment plan will be a focus of the fall task meeting planned for October 17-18 in Boston, USA following NAWEA/WindTech conference.

Schedule and Deliverables

		Year 1 (2019)												Year 2 (2020)												...Year 3 and 4...
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
Work Packages and Deliverables		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
Task Meetings	Kick-off Meeting			■																						
	Fall In-Person Meeting										■												■			■
	Spring In-Person Meeting															■										
WP0	D1 Task Presentation for Members							■																		
	D2 First Annual Progress Report									■																
	D3 Second Annual Progress Report																					■				
	D4 Third Annual Progress Report																									■
	D5 Final Report																									■
WP1	D6 Turbine Standards Forum in US		■																■							
	D7 Turbine Standards Forum in Europe						■																			
	D8 Turbine Standards Forum in Asia															■										
	D9 Turbine Standards Report				■	■	■	■	■	■						■										■
WP2	D10 Data Catalog Specification	■	■	■	■	■	■	■	■	■																
	D11 Development of Catalog																					■				
	D12 Data Catalog Instruction Guide																									■
WP3	D13 Electrical Standards Summary						■	■	■	■		■														
	D14 Review of Modeling Tools								■																	
	D15 Controls Assessment	■	■	■	■	■	■	■	■	■									■							
	D16 Isolated Power Best Practices Guide																					■				
	D17 Isolated Power State of the Industry Report																									■
WP4	D18 Engagement Plan				■	■	■	■	■	■		■														
	D19 Targeted Engagment																		■							
WP5	D20 Report																					■				

■ Completed
■ Progress
■ Planned

We are here

Outreach and Dissemination

Participation

- Extensive industry participation during standards listening sessions; other industry outreach just starting
- Outreach and engagment plan will be developed under WP4, starting at October task meeting

Papers and Presentations

- Website has been developed
- Task summary presentation developed and posted
- Presentation at Industry Encounter, WindEurope Conference & Exhibition in Bilbao, Spain

Publications

- No reports have been developed to date

Requests of the ExCo

As Task 41 gains traction, we would like additional support from the ExCo in three primary areas:

- Support for Task 41 participants with formal paperwork
- Identification of other potential task participants – specifically the UK, Italy, and Greece, all of which have active distributed wind markets
- As part of the wider distributed generation engagement efforts planned under WP 4, we would like your help in identifying parties and/or organizations that are working in the distributed energy space

Thank You!!

Bret Barker

Advisor for Distributed Generation and International Affairs to
U.S. Department of Energy, Wind Energy Technologies Office

+1 978-239-3933

bret.barker@ee.doe.gov

Administrative Updates

Participation

- Current participants: Belgium, China, Canada, Denmark, Ireland, Korea, Spain, and the USA. Expressed interest: Austria, Germany, Italy, and Japan
- Verbal commitments, need ExCo support in securing paperwork for all organizations

Budget

- Task Annual Budget: ~$75k
- Participation Fee (2018): $0, U.S. DOE covering all OA costs
- Overall Budget Status: ↑

Work Plan Status (*indicate the progress of each work package in work plan)*

- WP1: ↑
- WP2: ↑
- WP3: ↑
- WP4: ↑ + Effort just being initiated
- WP4: ↑ + Effort just being initiated

Backup Slides

Country Participation

	Country/Sponsor	Institution(s)
1	USA (OA)	National Renewable Energy Laboratory Pacific Northwest National Laboratory
2	Austria	Fachhochschule Technikum Wien
3	Belgium	Vrije Universiteit Brussel
4	China	China Wind Energy Association (CWEA), China General Certification (CGC), Goldwind, and Inner Mongolia University of Technology
5	Republic of Korea	Korea Institute of Energy Research
6	Spain	CIEMAT
7	Ireland	Dundalk Institute of Technology
8	Denmark	Denmark Technical University (DTU) & Nordic Folkecenter for Renewable Energy
9	Canada	Natural Resources Canada (NRCan)

Operating Agent: Ian Baring-Gould (National Renewable Energy Laboratory) and Alice Orrell (Pacific Northwest National Laboratory). All OA costs are being covered by U.S. Department of Energy.

How We Define Distributed Wind

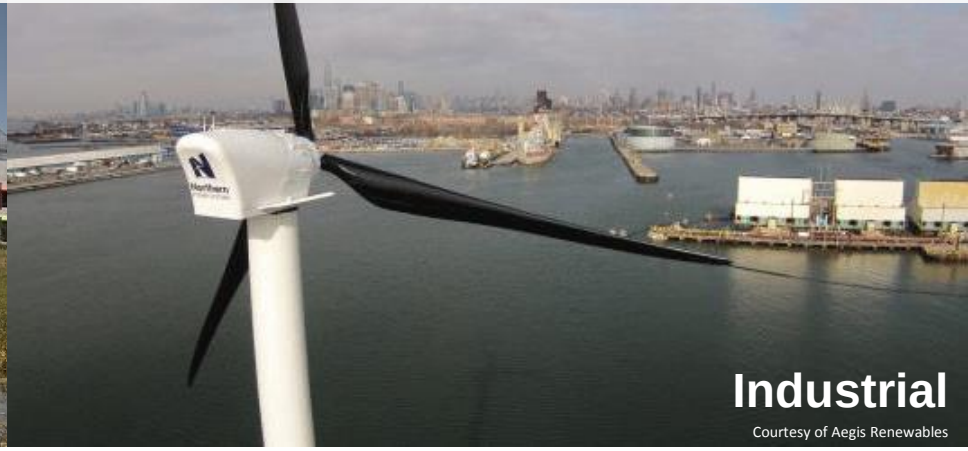
Wind connected at a distribution voltage (nominally at or below 70 kVA)

- Residential customers, including small businesses and farms, typically utilizing a single small (up to 100 kilowatts [kW] in size) wind turbine;
- Commercial and industrial customers, including large businesses, public facilities, and communities, typically utilizing one or more medium-scale (between 100 kW and 1 megawatt [MW]) or utility-scale (greater than 1 MW) wind turbines, and
- Small-scale municipal, community, or utility projects that use utility-scale turbines (greater than 1 MW) but only in small numbers installed on distribution networks.

Each can be deployed on or off large centralized grid networks with different business models (private, community, utility).

Typical Distributed Wind Applications

Wind energy technologies (of all size classes) are used as distributed energy resources on the distribution grid, on the customer side of the meter, or at an isolated off-grid location to support local loads or grid operations. Distributed wind systems are often used to self-generate power in remote communities or offset a portion of energy costs for grid-connected retail power customers.



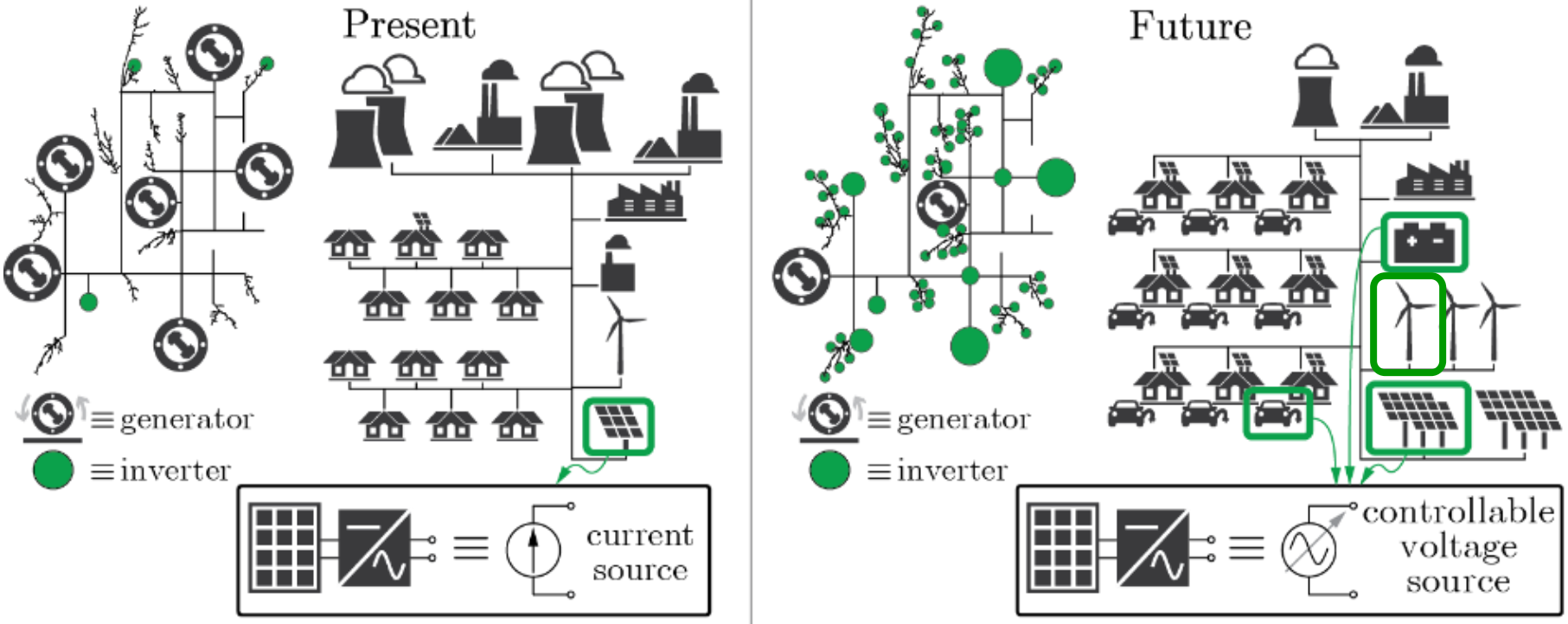
Task Motivation: Costs

- There have been large cost reductions in distributed energy resources, such as solar PV and energy storage, but limited cost reductions in turbine technologies less than 1 MW in size used in distributed and remote applications.

Task Motivation: Evolution of the Grid

- There are large potential distributed energy resource markets across the globe, particularly as grids evolve and the need for low-cost clean energy expands.
  - Distributed energy resources provide expanded grid diversity and resiliency.
  - There is expanded potential for distributed energy resources in areas of the world with weak transmission networks.
  - There is huge potential in energy access markets in developing nations (US$113 billion through 2030) and for isolated energy systems (micro-grids), both of which are currently dominated by solar PV.

Task Motivation: Evolution of the Grid



From grid-following controls → To next-generation grid-forming controls

The idea of what constitutes a grid is changing, especially in places with limited existing transmission infrastructure.

Need for Distributed Wind Collaboration

Expand engagement across IEA Wind, other IEA efforts, and distributed energy resources needed:

- IEA tasks with activities that overlap with identified distributed wind concerns and where the distributed wind efforts can receive valuable input. Key focus tasks: 25 and 28.
- IEA tasks that overlap with identified distributed wind concerns but that currently have limited distributed wind technology inclusion; engagement in these tasks may allow for inclusion and expanded focus on distributed wind challenges. Key focus tasks: 19, 26, 34, 36, and 39.
- IEA tasks outside of wind that are addressing technologies or markets in which distributed wind could or should engage. IEA work on PV, storage, and other distributed energy resources.
- Distributed wind information is needed in larger distributed energy resources discussions; wind TCP can be a valuable resource in this area.
- There are few collaboration opportunities for distributed wind researchers.

How We Got Here

- IEA Task 11 Distributed Wind TEM in March 2018
- Task 27 (Small Wind Turbines in High Turbulence Sites) completed efforts at the end of 2018
- Expanded U.S. efforts in the distributed wind market segment, allowing a strong incentive for expanded international engagement
- Provisional approval provided at ExCo 82
- Kick-off meeting in March 2019, participation by interested countries to discuss work packages
- Task approved at ExCo 83 for a 4-year term.

WP1: Design Standards

Current design standards are not working for small and mid-size wind technologies.

Planned efforts:

- Conduct assessment of current needs
- Complete research to justify any changes
- Make recommendations to TC88 on proposed changes

Lead: USA; NREL

Participants (expressed): Belgium, China, Denmark, Ireland, Japan, Spain, and the USA

WP2: Data Information Catalog

Develop an information-sharing catalog for distributed wind research and data

- Planned efforts:
  - Identify requirements / develop specification
  - Identify potential data contributors and users; what shared resources are needed; what data are available on key topics; and recommended practices for data collection, reporting, accessing, and storage
  - Data collection
  - Catalog and make available metadata about distributed wind datasets so researchers can contact data owners directly about using the data
  - Consider including data processing tools and decision-support tools
  - Develop catalog
  - Develop instructional guide.
- Participants: China, Denmark, Ireland, Spain, USA (lead)

WP3: Integration of Distributed Wind

Expanded work is needed to integrate distributed wind into grid and off-grid power systems including expanded controllability, cyber security, and advanced grid services.

Planned efforts:

- Best practice guides on key requirements
- Support of external standards development
- Documentation of operational examples.

Lead: USA; NREL

Participants (expressed): China, Denmark, Ireland, Korea, Spain, Canada, and the USA

WP4: Outreach and Collaboration

The distributed wind industry needs to become much better at collaborating with ongoing research efforts across IEA and the DER community.

Planned efforts:

- Identify and engage with other wind TCP efforts: Tasks 25 and 28. Potentially important engagement with: Tasks 19, 26, 34, 36, and 39
- Expand engagement with other IEA efforts (PV, storage, grid)
- Expand outreach to key DER sectors with standardized outreach information

Lead: Operating Agent, USA

Participants: All members. Good cross-collaboration with existing wind TCP efforts based on current members

WP5: Innovation and Down-Scaling

Expanded sharing of research and technology innovation is required to reduce lifecycle costs of energy (LCOE) for small and mid-size turbines.

Planned efforts:

- Assess utility turbine downscaling opportunities
- Summarize international LCOE cost reduction roadmaps
- Share LCOE reduction best practices and experiences

Lead: Spain; CIEMAT

Participants (expressed): Spain and USA